**Payload**

- AltiCam600-1000FF, on-board feed-forward, Sony FCB-EX1000

- AltiCam600-6000FF, on-board feed-forward, DRS E6000 LWIR/62mm lens

- Auxiliary outputs for beacons

**Attachment System**

- Tee-Bar with 3 quick connect clips to blimp's bridles

- Pitch level control system

**Ground Station**

- Panasonic CF-30 *Toughbook* laptop with "AltiCam 2008 GUI" interface to steer turrets, control imagers, process and record video

- CH Product 3 axis/10button USB Joystick

- Ethernet Over Power (EOP) for video & serial communication

- 500ft powered tether, single 24AWG min twisted pair for 500ft

*Photo*: *Hood Technology's dual turret system under a tethered 14ft diameter SkyDock balloon*

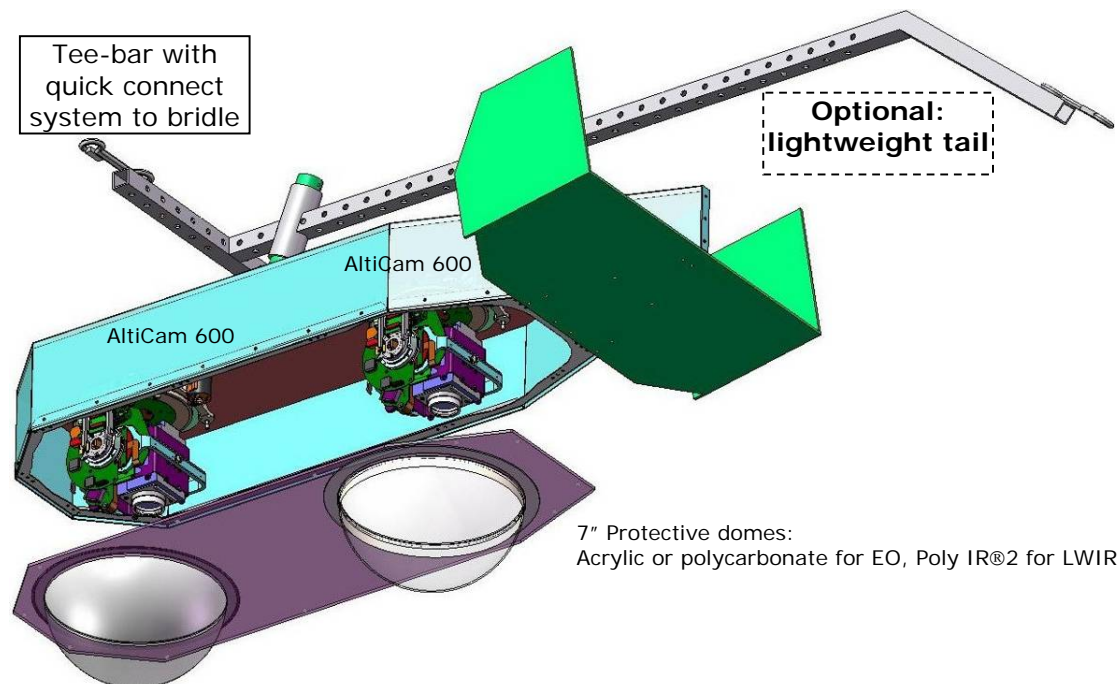# Contents

# 1. System Description

## 1.1 General

Hood Technology's AltiCam Dual Turret System for SkyDock aerostat is comprised of three parts:

- Payload:
    - Weather proof enclosure
    - Two AltiCam 600 FF turrets (FF for internal feed forward)
    - Sony FCB-1000 imager in the visible band
    - DRSE6000 imager LWIR with 62mm lens
    - AC/DC converter, 4 port video server, 4 port TCP to serial port server
    - Pitch leveling electronics
    - Ethernet Over Power (EOP) terminal
    - Single 3-position weatherproof cylindrical connector to tether
    - Auxiliary outputs for two beacons
    - Optional tail

- Attachment system:
    - Tee-bar
    - Quick connect to bridle attachment points
    - Quick connect to payload
    - Quick connect Safety pin
    - Yaw hinge, can be locked
    - Electrically actuated pitch hinge with active damping

- Ground station
    - Panasonic *CF-30 Toughbook* Laptop
    - 3 axis / 10 button USB joystick
    - Ethernet Over Power (EOP) terminal
    - Requires pure sine wave 60Hz inverter with no surge protection
    - Hood Technology's user interface including optional RTVS image processing software for de-jitter and tracking

## 1.2    Payload "Canoe"

### 1.2.1  General

Tee-bar with quick connect system to bridle

Optional: lightweight tail

AltiCam 600

AltiCam 600

7" Protective domes:
Acrylic or polycarbonate for EO, Poly IR®2 for LWIR

- Hood Technology's dual turret system is housed in a sheet metal enclosure with fiber glass roof and a carbon fiber floor holding two 7 in domes forming a "canoe".

- The domes are polycarbonate or acrylic for EO; Poly IR®2 from Fresnel for LWIR.

- A light weight carbon tail can be attached to the end of the canoe.

- The canoe houses:
  - Two AltiCam 600 gyro-stabilized turrets with EO or IR imagers (see Section 1.2.2)
  - An Ethernet Over Power module (EOP)
  - A 4-channel video server (NTSC to MPEG)
  - A 4-channel port server (serial to TCP/IP)
  - The drive electronics for pitch leveling, including a pitch rate gyro

- The canoe has three electrical connectors on its roof:
  - Amphenol Miniature Cylindrical connector PT02A-8-2P 2 position receptacle (MIL-C-26482, Series 1) to tether:  60Hz sinusoidal, 120VAC nom. (90VAC min)
  - Hirose Electronic miniature waterproof plastic receptacle, 3-position, for pitch level motor, 5VDC, 1A
  - Hirose Electronic miniature waterproof plastic receptacle, 6-position, for 2 beacons, 15VCDC, 1A

- The canoe specifications are:
  - Dimension:  32in x 10in x 14in
  - Weight 11.5 lb.

### 1.2.2 Gyro Stabilized Turrets
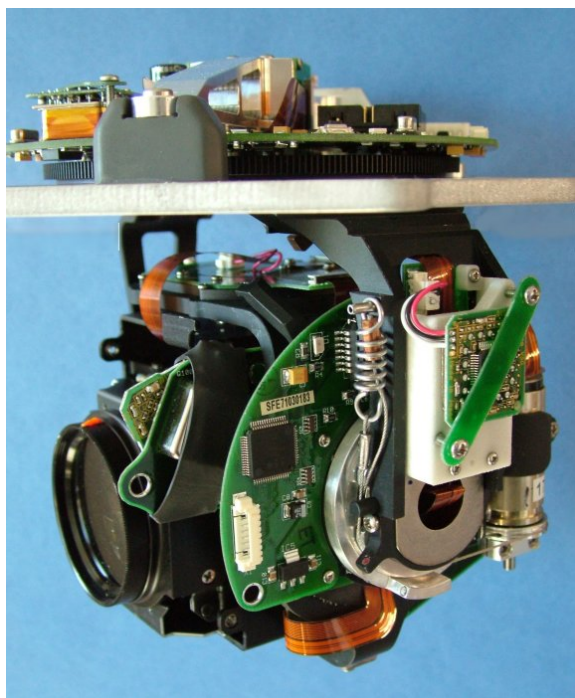


**ALTICAM 600-1000-FF**
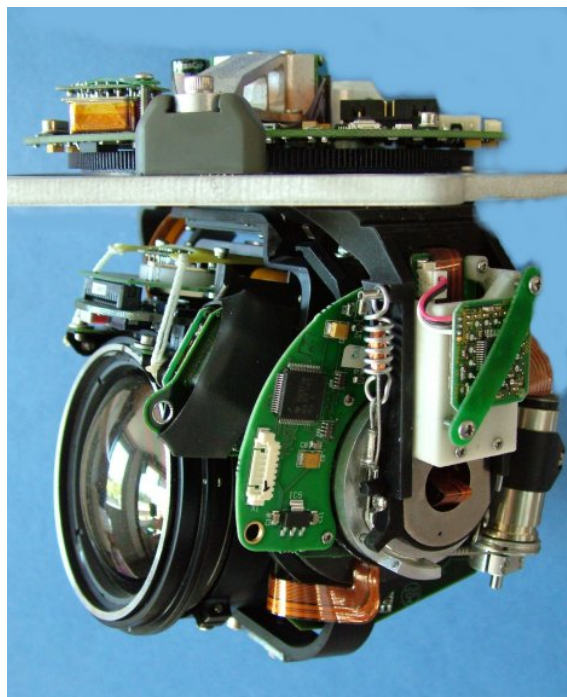
Motion/Stabilization

- Pan: continuous,
  60°/sec max commanded rate

- Tilt: -90° to +20°, 60°/s max commanded rate

- Scan/Tilt Rate Feedback Gyros

- Pan/Outer Tilt Rate Feed Forward Gyros

Imager        Sony FCB-EX1000

- 57.6° (1000mils) to 1.8°(31 mils) Horizontal Field Of View with optical zoom

- 0.6° (11 mils) with 3x digital zoom

- Shutter speed 1/10,000 sec to 1/1sec

- Backlight, Near Infra Red (NIR) function for dawn/dusk

Power (direct, stabilized, peak)

- 6W/11W/12W



**ALTICAM 600-6000-FF**

Motion/Stabilization

- Pan: continuous,
  60°/sec max commanded rate

- Tilt: -90° to +20°, 60°/s max commanded rate

- Scan/Tilt Rate Feedback Gyros

- Pan/Outer Tilt Rate Feed Forward Gyros

Imager        DRS E6000

- 15° (262 mils) Horizontal Field Of View

- 5° (53 mils) with 3x digital zoom

- Shutter speed 1/60 sec

- Focus system

- Black hot/white hot, brightness contrast adjust

Power (direct, stabilized, peak)

- 8W/13W/20W (shutter)

## 1.3    Attachment System

### 1.3.1  Tee Bar

The tee-bar connects the payload to the blimp by bridging to all three bridles.  Tee-bar attachment points are located on the bridles, ready for quick connect.

The Tee bar is made of welded aluminum.  It has a welded shaft for quick payload connect.  Each end has a quick connect clip to attach to the Tee-Bar Attachment Points on the bridles.

---

**WARNING**

The clips are tested to 100 LB. in all directions.

The welded Aluminum tube has limited strength (100 LB.)

**THE TEE-BAR IS A 100 LB. MAX STRUCTURAL ELEMENT.  DO NOT OVERSTRESS.**
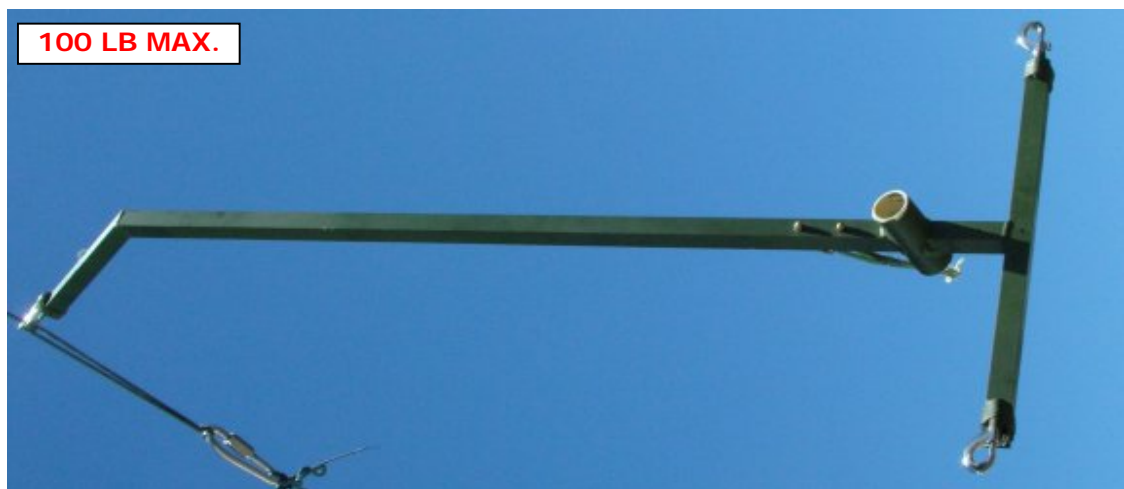
---

**100 LB MAX.**

**Figure 1:  Tee-Bar with Yaw Tube for quick connect to payload, three clips for quick connect to the blimp**

The canoe quick attachment system consists of a Tee-bar connected to the 3 bridles that receives an articulated tube that allows for pitch and for yaw freedom.

Pitch is used to level the canoe no matter how the blimp is flying (high wind, low wind, Section 1.3.2).

Pitch can be locked if the pitch control system is defective.

Pitch control is actuated by a DC motor.

The Yaw articulation decouples the payload from the trapeze mode that results from the unique 3 bridle attachment system.

Yaw can be locked if the blimp cannot be tuned properly to fly well with the payload.

### 1.3.2  Pitch Leveling

Wind makes the blimp fly at a wide variety of pitch angles (Figure 2).  The payload must remain level in order to guarantee the best Field of Regard.  Hence the canoe is hanging from the tee-bar through a **hinged tube**.

Gravity and aerodynamic forces level the canoe, but the pendulum motion must be damped out.  A pitch leveling system using a geared DC motor driven by electronics internal to the canoe is used for that purpose (Figure 3).

Pitch leveling critically damps out the pitching motion induced by sudden fore-aft and up-down motion of the blimp; the drive electronics relies on a pitch rate gyro.

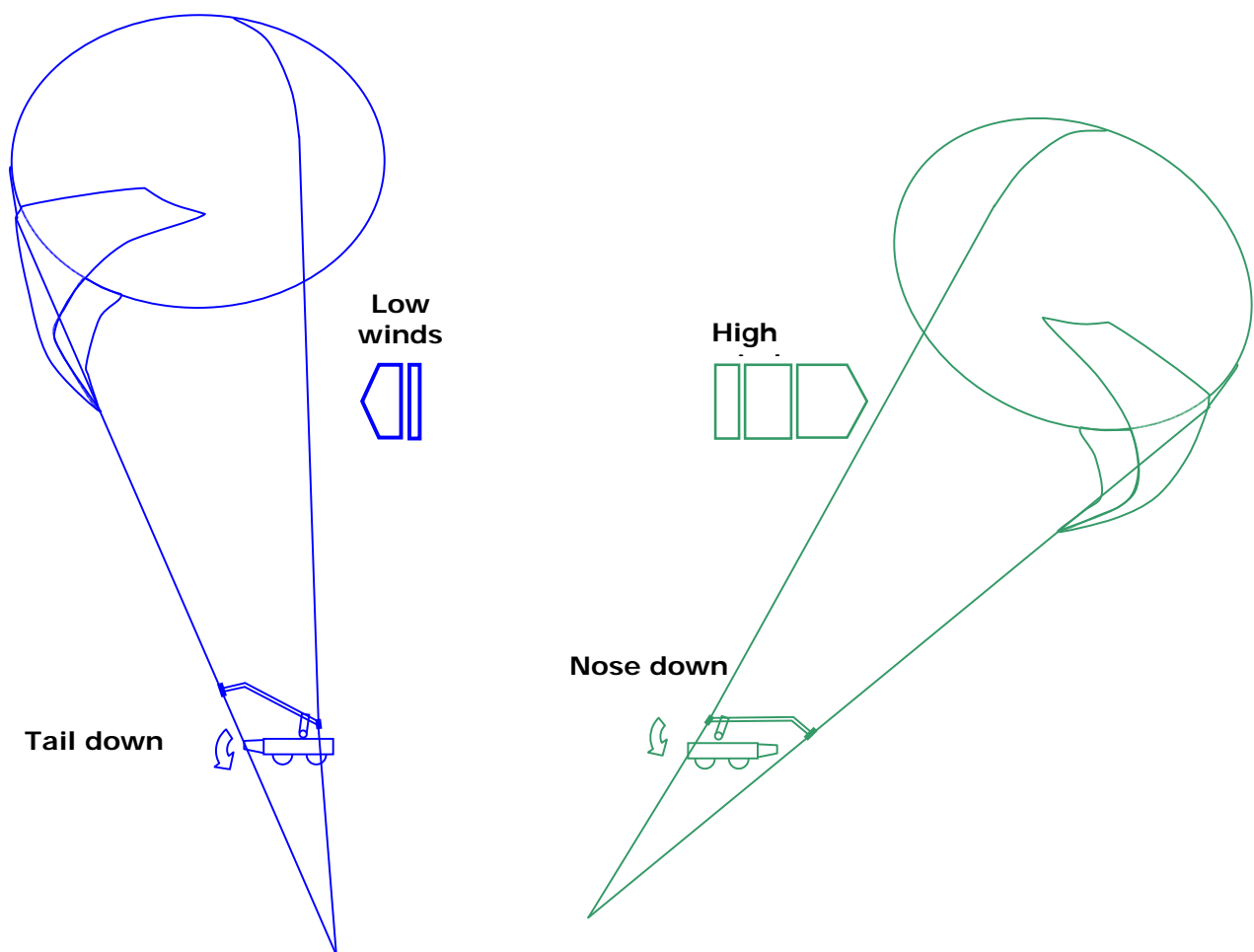Additionally, pitch leveling let the operator raise or lower the nose of the canoe as needed.



**Figure 2: Blimp position versus wind conditions: to remain level, the canoe must be articulated in pitch.  An unarticulated canoe would otherwise mask large portions of the field of regard.**
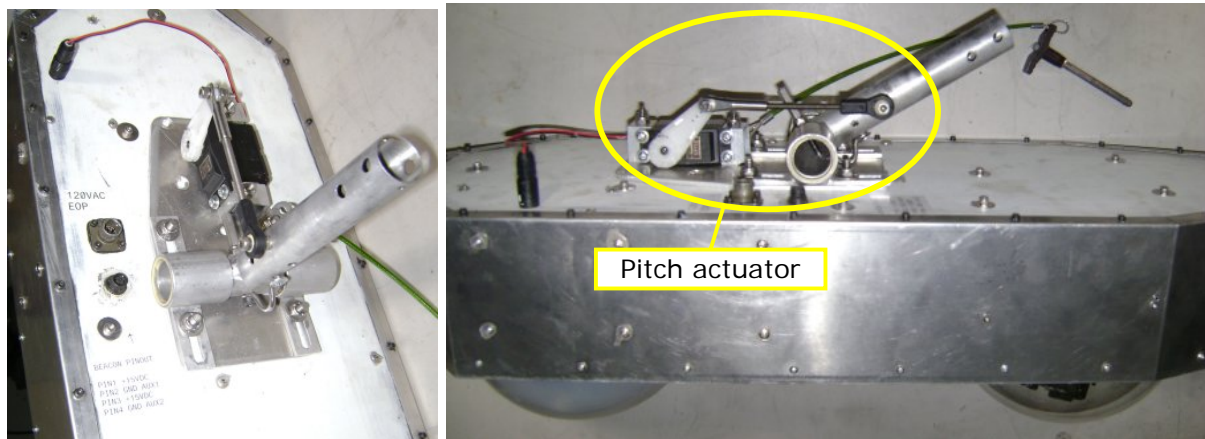
**Figure 3: pitch leveling system: DC motor actuated by electronics inside the canoe, with active damping based on pitch rate gyro output.**

### 1.3.3 Auxiliary Outputs

The 6-position connector allows one to connect two 12VDC Low Profile Light Strobes.

(500mA per channel at 15VDC, e.g.:, 70 strobes per minute, 50 Candela seconds, 2000 hours bulb life, McMaster Carr 57545T37).

Power to each strobe light can be turned on or off independently.

The strobe function is not provided by the switch (that is, does not turn on for 100msec every second).

## 1.4 Ground Station

### 1.4.1 Laptop

The entire payload can be controlled from a laptop running Hood Technology's Ground Station utility.

Hood Technology's Ground Station allows the following operations:

- Steer turrets independently or in slaved mode.

- Control the imagers (zoom, focus, brightness etc.)

- Optional:  Advanced Video Features.

    o  Process the incoming video to remove jitter.

    o  Track objects in a scene of lock the turret Field Of Regard onto a specific scene.

- Record video, record stills and replay video.


Any laptop with an RJ-45 network port can interface with the payload.

If Advanced Video Features are purchased the laptop must be capable of comfortably running the Real-Time Video System (RTVS) application when video is streamed at half rate (15 Frames per sec).  This provides good quality video.

The Panasonic *Toughbook* CF-30 is the baseline laptop for the Ground Station.  It is capable of running the RTVS application at full rate (30 Frames per Sec (FPS) ).

### 1.4.2 Ethernet Over Power (EOP)

To limit the weight of the tether, an Ethernet over Power module is used to send Ethernet signal (TCP/IP) on the same twisted pair conductors as the one used to send 60HZ-120VAC power transmission lines.

The EOP device used in the canoe is a NETGEAR XE104 with 4 available ports.  Its maximum rate is 85 Mbps.

### 1.4.3 Software

The following are the main icons located on the desktop necessary to operate the dual payload:

C:\Program files\AltiCam GUI 2008\AltiCam GUI 2008.exe:  this is the Ground Station Program for the dual turret payload.  This program allows one to connect video and serial communication to and from both turrets; steer the turrets; control the imagers (zoom, focus, etc.); process, record and replay videos and stills.

This directory is optional.  In order to manage recording, each video is saved as yy-mm-dd_hh.mm.ss.avi.  The directory where videos are stored can be selected from the main page of the User Interface program and saved in the settings.  Figure 4 shows an example of how to further organize videos. Getting organized is an important step in video surveillance
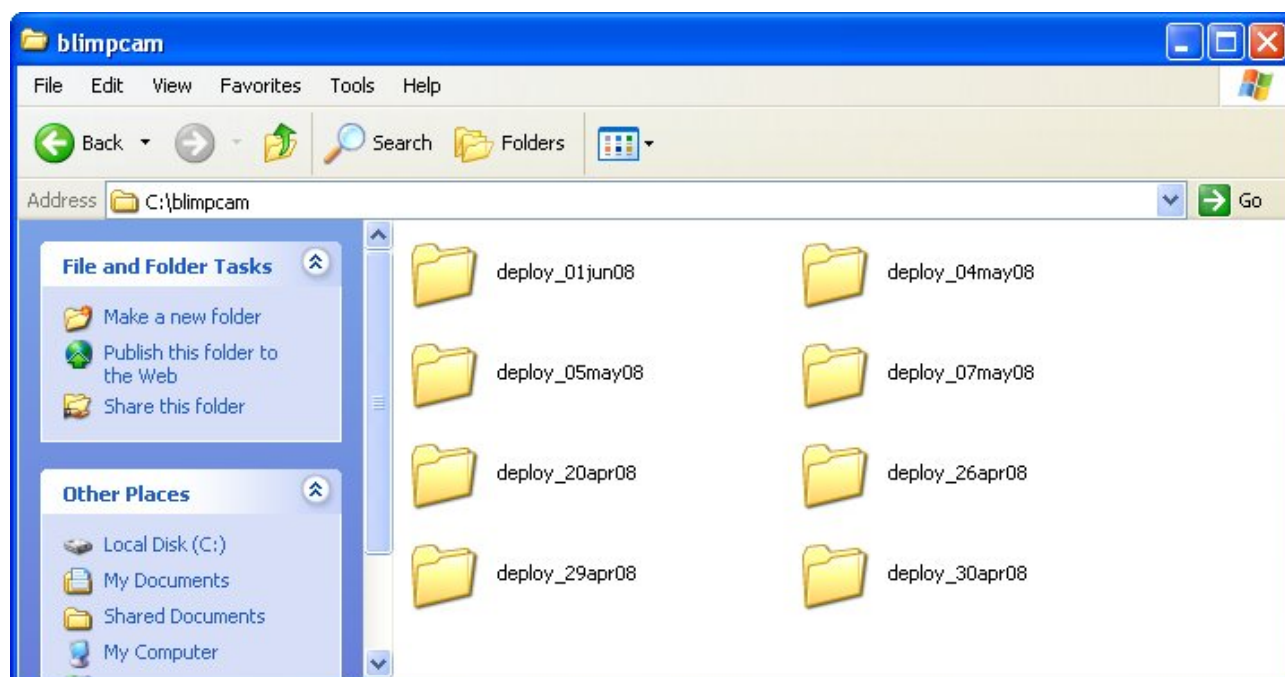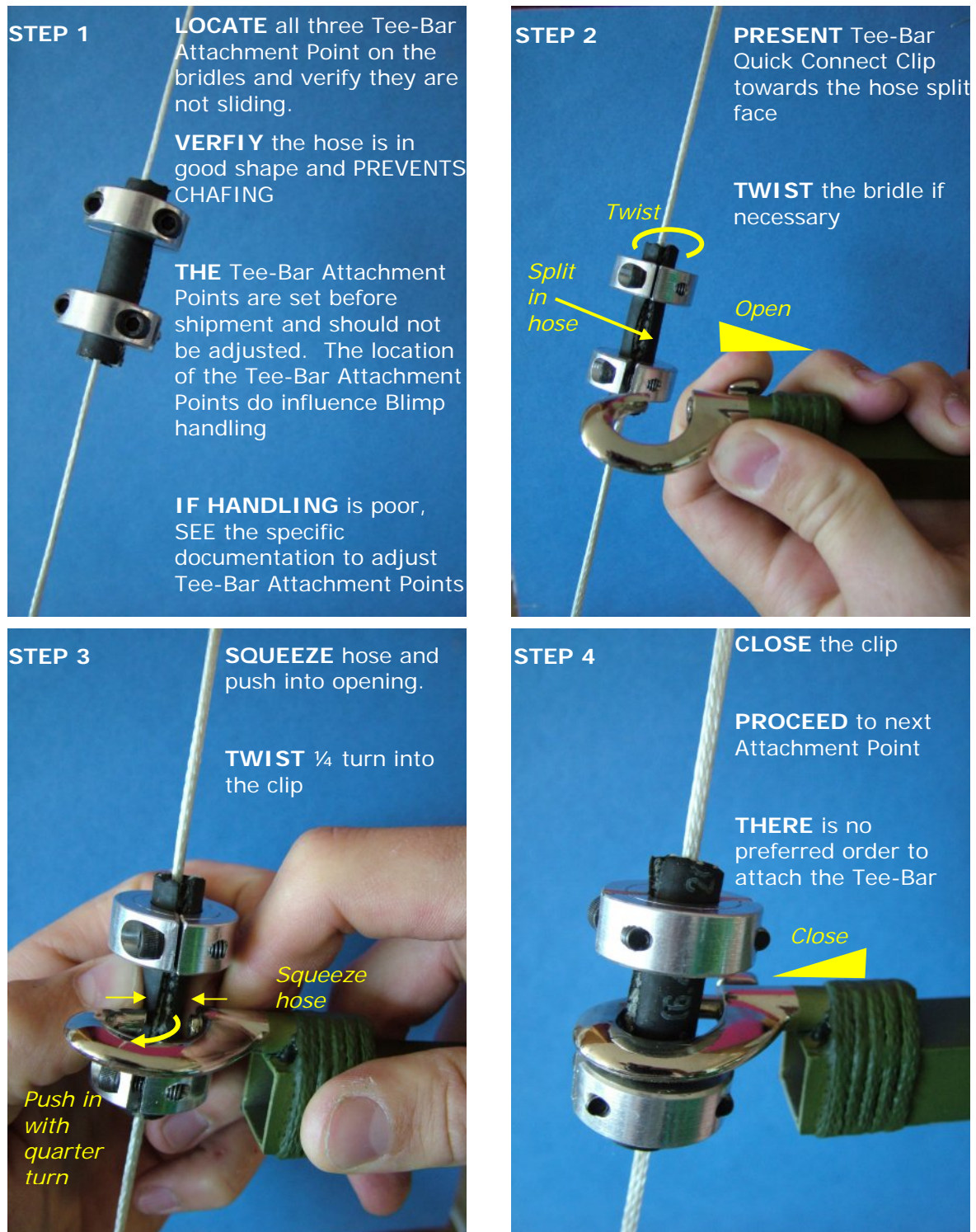
**Figure 4: example of video organization**

The diagnostics folder contains shortcuts to diagnostics applications that will help troubleshoot the system in case video and communication cannot be established with the payload (see troubleshooting Section 8)

## 2. Payload Installation

### 2.1 Attaching the Tee-Bar to SkyDock

**STEP 1**

**LOCATE** all three Tee-Bar Attachment Point on the bridles and verify they are not sliding.

**VERFIY** the hose is in good shape and PREVENTS CHAFING

**THE** Tee-Bar Attachment Points are set before shipment and should not be adjusted. The location of the Tee-Bar Attachment Points do influence Blimp handling

**IF HANDLING** is poor, SEE the specific documentation to adjust Tee-Bar Attachment Points

**STEP 2**

**PRESENT** Tee-Bar Quick Connect Clip towards the hose split face

**TWIST** the bridle if necessary

*Twist*

*Split in hose*

*Open*

**STEP 3**

**SQUEEZE** hose and push into opening.

**TWIST** ¼ turn into the clip

*Squeeze hose*

*Push in with quarter turn*

**STEP 4**

**CLOSE** the clip

**PROCEED** to next Attachment Point

**THERE** is no preferred order to attach the Tee-Bar

*Close*

The Tee-Bar Attachment Points should be connected to the Aerostat's bridle lines. Consult the Aersotat User's manual for more information.

## 2.2 Attaching the Payload to the Tee-Bar

1. Remove the safety pin (press button in the middle of the handle to release catches)

2. Slip "Canoe" shaft inside Tee-bar yaw tube.

3. Align the pin holes (lock yaw) or attach the buckle (free yaw)

4. Insert the Safety Pin

5. Electrical connection:

   o Tether, **C1**:  3-position Amphenol miniature Cylindrical connector

   o Beacons **C2**: 6-position waterproof plastic connector

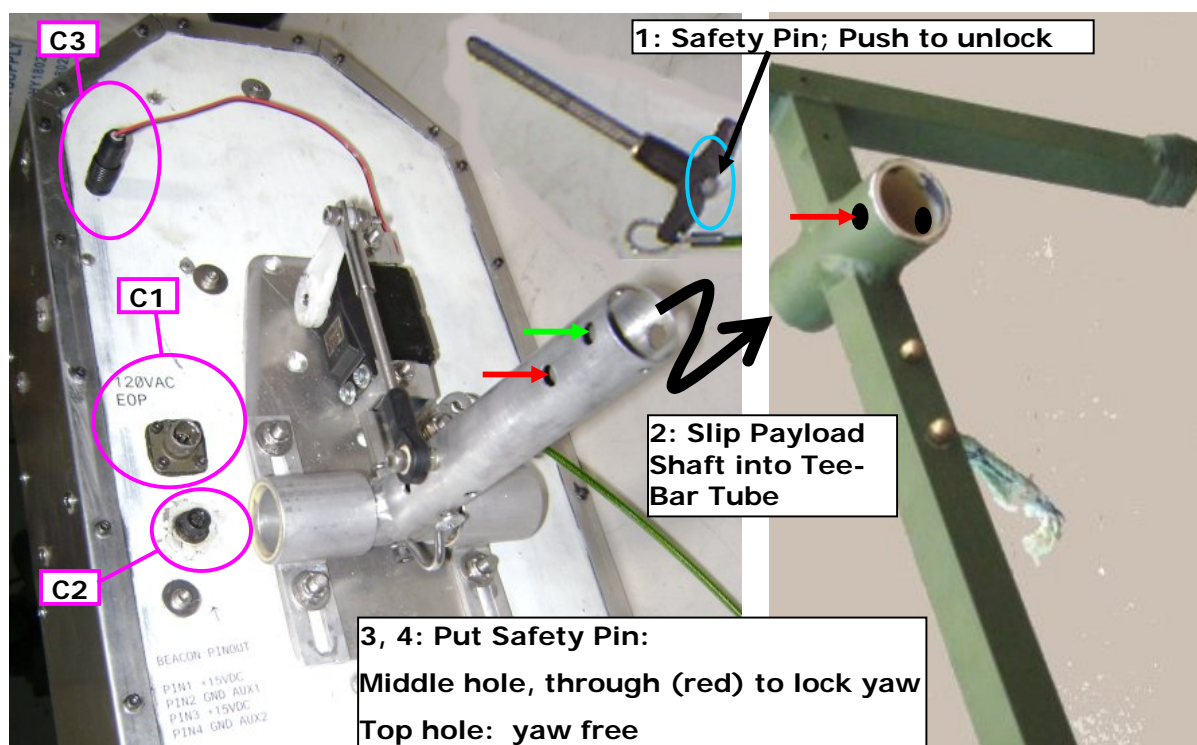   o Check that pitch level motor is plugged in (**C3**, 3-position waterproof plastic connector)



**Figure 5:  Connecting the payload to the Tee-Bar**

---

**RECOMMENDATION**

We recommend attaching the Tee-Bar to the blimp first and checking how the blimp flies with a tether length of 30-50 ft.

We then recommend "walking" the blimp down, attaching the payload to the Tee-Bar, securing the payload and making the electrical connections

---

## 3.    Ground Station Installation



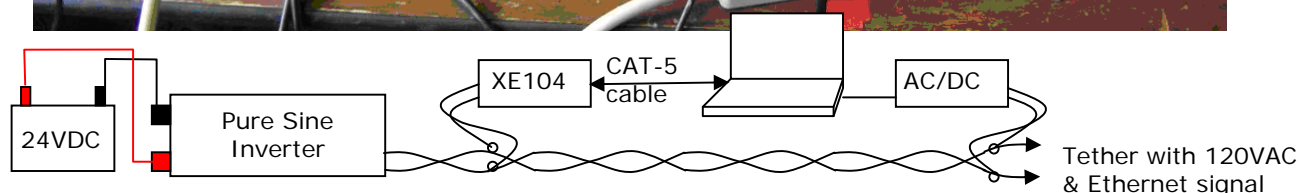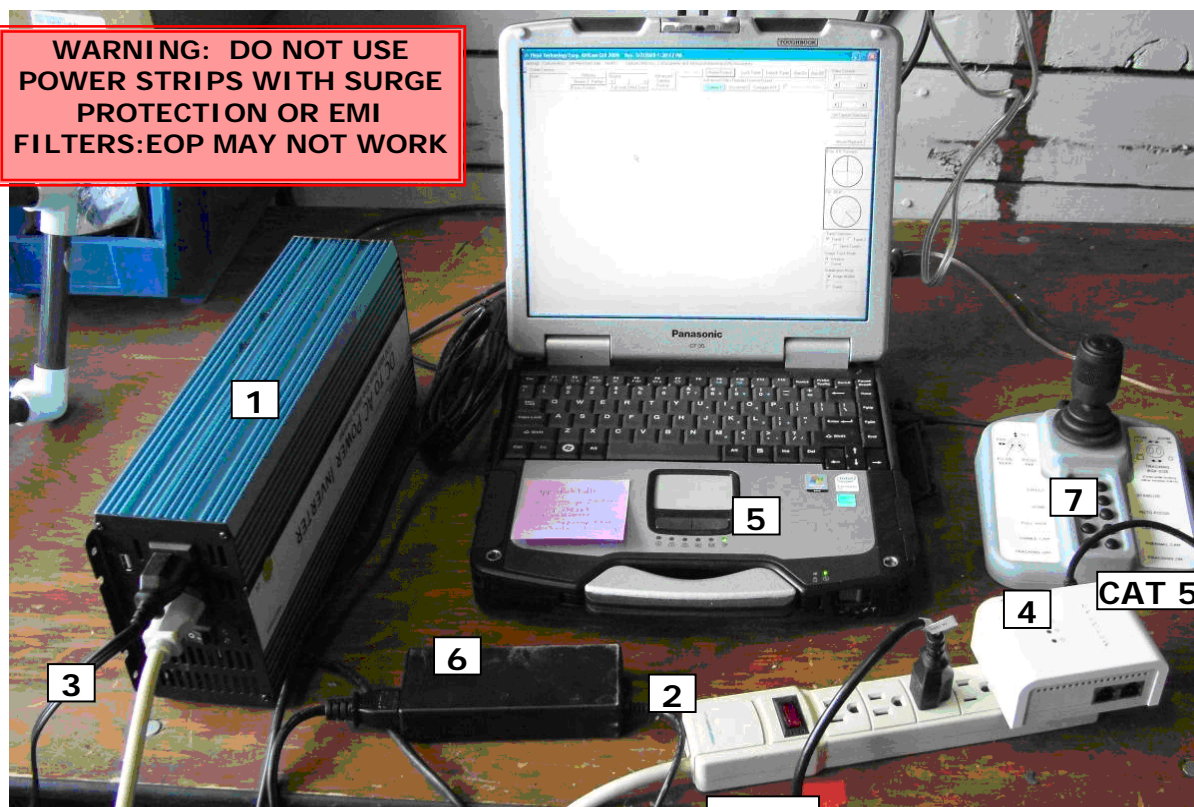**WARNING:  DO NOT USE POWER STRIPS WITH SURGE PROTECTION OR EMI FILTERS:EOP MAY NOT WORK**

**Figure 6:  Ground Station Connections**

All items and connections described in Figure 6 and Table 1 can be found in the blimp trailer and most connections are already built-in.  The operator need only perform the following:

- Connect laptop to NETGEAR Ethernet Over Power (EOP) through CAT-5 cable.
- Connect USB joystick to laptop.
- Connect laptop to power.

**Table 1:  Ground Station Connections**

| item | Description | Connection |
|------|-------------|------------|
| 1 | Pure Sine Wave 110VAC Inverter | 24VDC battery |
| 2 | Power Strip | connected to 120VAC from 1 |
| 3 | Tether power | connected to 120VAC from 1 |
| 4 | NETGEAR XE104 | connected to 120VAC from 1 |
| 5 | Panasonic C30 ToughBook Laptop | connected to NETGEAR XE104 through CAT 5 |
| 6 | Laptop power supply | connected to 120VAC from 1 |
| 7 | 3 axis/10 button USB joystick | connected to Toughbook through USB port |

## 4. Operations

### 4.1 Starting Up, Connecting

1. Once the blimp is deployed, connect the ground station elements as described in Section 3 and power up the payload.

2. Start the Ground Station program.

3. On the main page, CONNECT to the payload (press the blue connect button). The connect button changes to connect when both video and communication are properly connected.
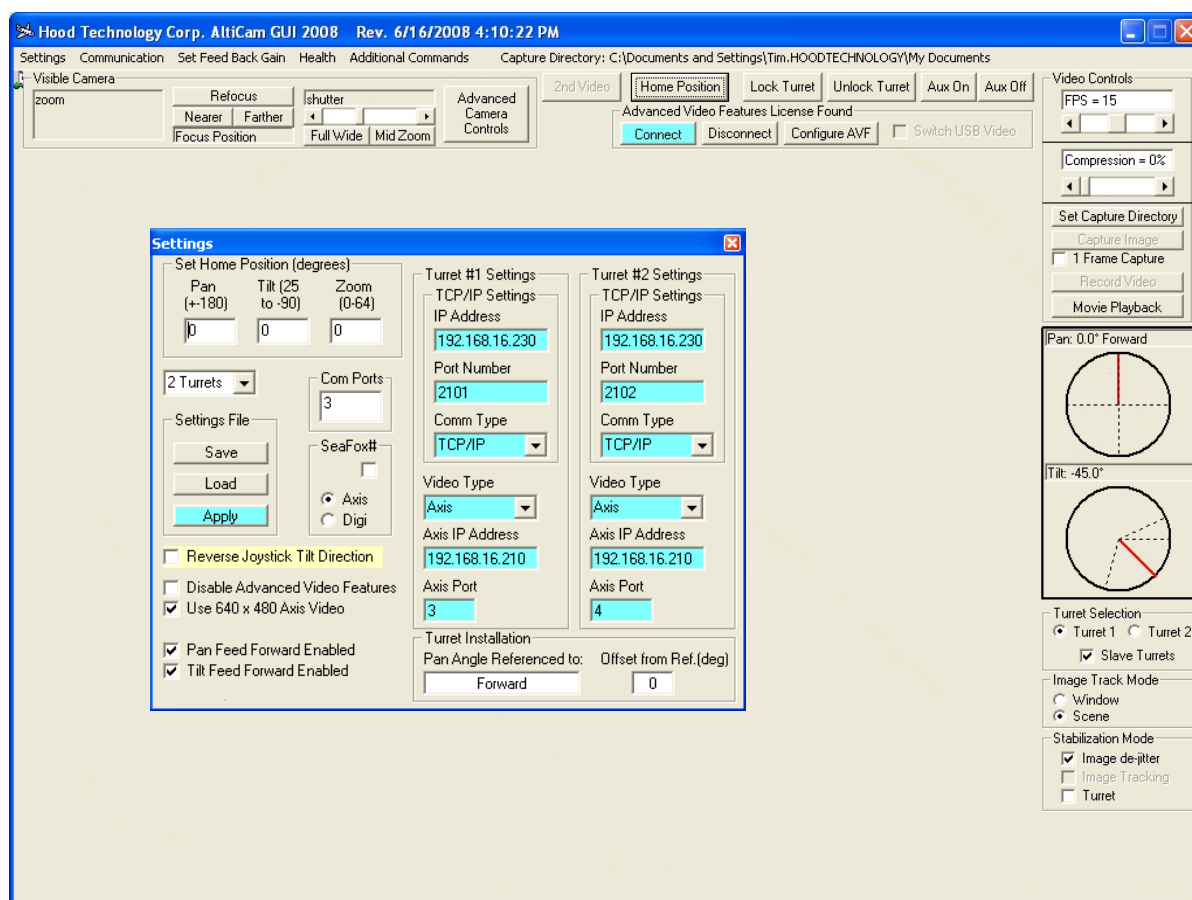


**Figure 7: Hood Technology's AltiCam Graphical User Interface, Settings window with default parameters for EOP operations (TCP/IP: 192.168.16.230, Port 2101 and 2102, Video = axis, IP 192.168.16.210, Port 3 and 4.)**

**TIPS:** when power is applied to the tether, the EOP responds in about 15 sec and can be checked using the XE104 utility in the diagnostics folder (see Section 1.4.3)

The video server (AXIS241Q) wakes up and connects in about 30 sec to 60 sec.

The Port Server takes 90 sec to 120 sec to wake up and connect from a power-up.

If the connect button on the main application is pressed and the Port server fails to respond, the "settings" window will appear with most fields blue.

To connect, press the Apply button until all fields turn ▭ , including the Apply button.

## 4.2 Starting Up: Joystick Control, Stabilization Mode

### 4.2.1 Basic Joystick Operations
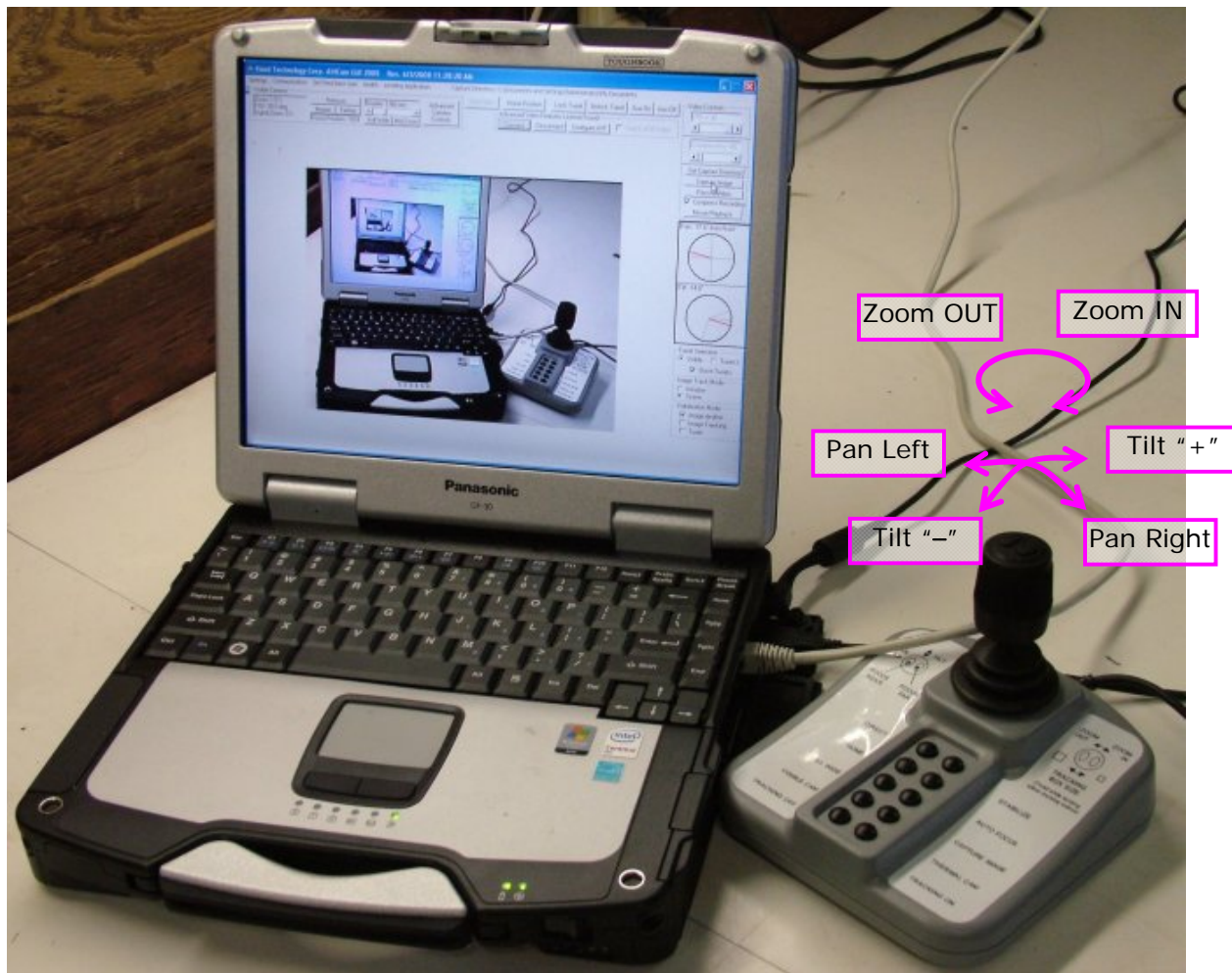


**Figure 8: Ground Station: laptop + joystick**

- Pan:        Move Left = Pan Left,
                 Move Right = Pan Right


- Tilt:  Operator selectable in "Settings" ("Settings can be saved, to create default)

    o "Airplane Mode"

              Push    = Move image down ("Nose down"),
              Pull     = Move image Up ("nose up")

    o "Video Game Mode"

              Push or Move Up        = Move image Up,
              Pull or Move Down     = Move image Down


- Zoom:    twist right = Zoom in,
                 twist left = zoom out

### 4.2.2  Stabilization Modes
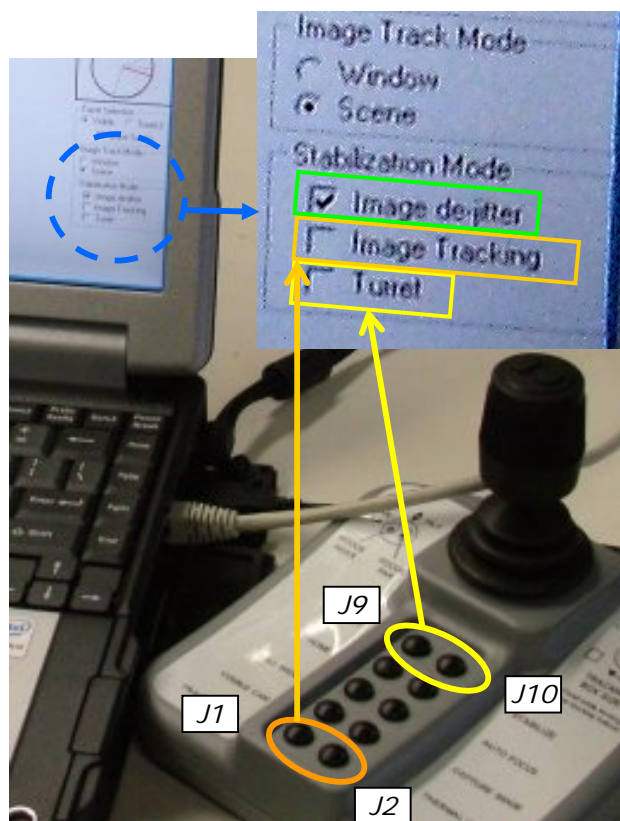


Turret Gyro Stabilization ON:

- Check "Turret" in "Stabilization Mode" window or press top right button on Joystick Pad

Turret Gyro Stabilization OFF: (save power)

- Uncheck "Turret" in "Stabilization Mode" window or press *J9* on Joystick Pad

Image Stabilization Modes(AVF[*]):

- Check "Image de jitter" for any Advanced Video Features or Hold *J1* and press *J10* on the Josytick Pad (*J1-J9* off)

- Check "Image Tracking" or press *J2* on the Joystick Pad to lock image (Scene mode, "S" on keyboard) or track object (Window mode, "W" on keyboard).

- Uncheck "Image Tracking" or press *J1* on the Joystick Pad to acquire new scene or track new objects.

**Figure 9:  Stabilization Modes**

Image quality is obtained using the superposition of:

- Gyro stabilization that slews and tilts the imager inside the turret to counter blimp motion and

- Image processing that "de-jitters" the image, can track objects and can drive the turret to maintain the object in its field of view.

Notes:

- The RTVS image processing software is optional.

- Image de-jitter must be on for image tracking to be operational.

- RTVS may be turned off in low light or low contrast conditions or when the scene has no distinctive "edges"
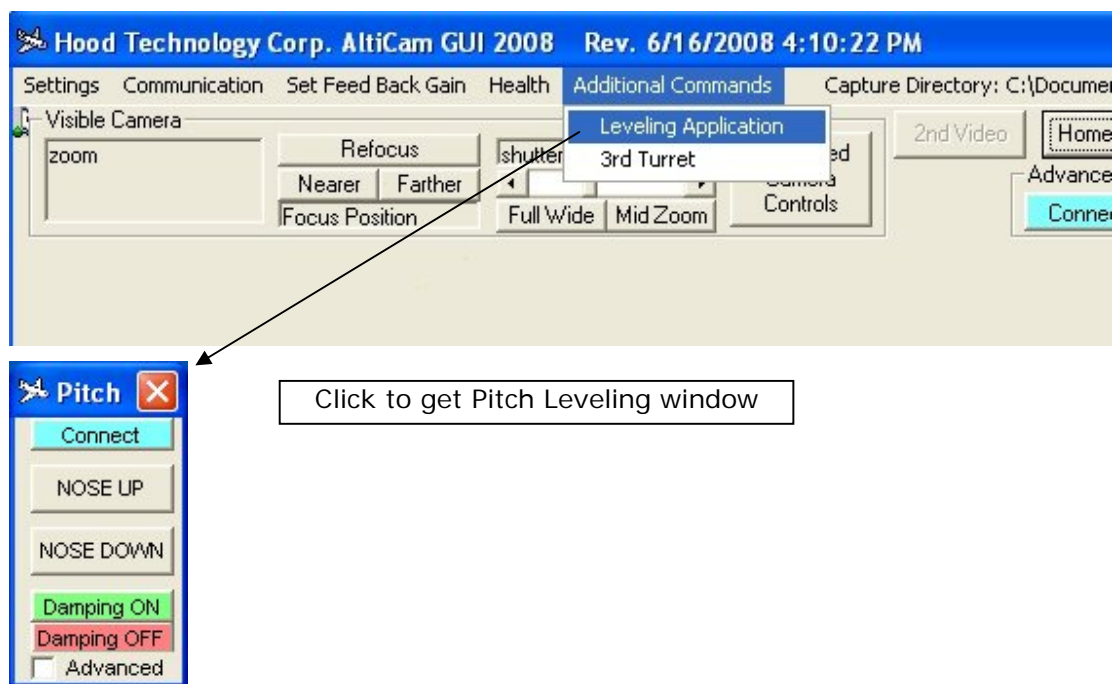
## 4.3    Starting Up:  Pitch Level



**Figure 10:  Pitch Level Window**

Pitch damping is nominally off.  Pitch damping is very effective whenever wind conditions are changing and the blimp oscillates between low wind and high wind equilibrium conditions.  In the Menu bar of the Ground Station window:

- Select Additional Application> Leveling Application

- A new window, "Pitch", appears:
  o press the blue ⟦ connect ⟧ button until it changes to ⟦ connect ⟧.
  o Once connected, the pitch damper should be turned on by clicking on the ⟦Damping ON⟧ button.
  o To raise the nose (lower the tail), click on the ⟦ NOSE  UP ⟧ button repeatedly.
  o To lower the nose (raise the tail), click on  the ⟦NOSE DOWN⟧ button repeatedly.

The window has "advanced features" that are covered in the Graphical User Interface Reference Manual.

## 5.    Power Specifications

INPUT:

Voltage        90 VAC to 120VAC

Frequency      60 Hz

Distortion     PURE SINE WAVE preferred.  (Wall power, PURE SINE WAVE INVERTER)

Power          80W peak

OUTPUT

Pitch Level    1x   5VDC, 1.0A

Beacon         2x 15VDC, 0.500A


Estimated Tether loss:  ,max power

| Gage | Resistance in Ohms ($\Omega$) per 1,000 ft | Power Loss 500ft | Min Delivered Voltage for 500 ft tether |
|---|---|---|---|
| 20AWG | 10.15$\Omega$ | 7W | 113VAC |
| 22AWG | 16.14$\Omega$ | 11W | 110VAC |
| 24AWG | 25.67$\Omega$ | 17W | 103 VAC |


Notes:

These estimates consider peak power demand from the canoe, including beacons.  The table indicates that 24AWG wire can be used for distances of 500ft.

The AC/DC converter inside the canoe requires 90VAC as a minimum.

The EOP NETGEAR XE104 system tolerates much lower voltages (50VAC) BUT is very sensitive to rapid load changes.


## 6.    Environmental Specifications

All equipment has been tested to properly work from 0°C ambient (32°F) to 50°C ambient (122°F)

## 7.    Typical Performance

### 7.1    EO System:  Sony FCB-EX1000

#### 7.1.1  Field Of View (Horizontal)

- 57.6°        (1,000 mils)  at zoom 1x

- 1.8°         (31 mils)      at zoom 36x (full optical)

- 0.6°         (10 mils)      at zoom 110x (36x optical 3x digital)

Notes:

Aspect Ratio   4/3 (Horizontal Field-Of-View = 4/3 * Vertical Field Of View, standard TV format)

Digital Zoom: beyond 3x digital zoom, the image becomes noticeably "boxy" hence compound zoom is limited to 110x = full optical x 3 digital

Beyond zoom of 25x or 2.5° (44 mils), the image loses its sharpness.

#### 7.1.2  Brightness/Contrast

Image Brightness / Contrast are controlled by:

- Shutter speed 1/10,000 sec (bright conditions) down to 1/60 sec (dark) down to 1 sec.

- Brightness adjust (electronic gain)

- Near Infrared Cut-Off filter (NIR ON, NIR OFF function)

Notes:

When the shutter speed is less than 1/60 sec, the camera sends only "half-field".  The image rate is less fluid (looks like stop and go).  Residual blimp motion makes the image blurry.  It is recommended not to go slower than 1/60 sec

The NIR function allows one to operate up to 15 min past sunset or 15 min before sunrise. The NIR function also allows one to monitor areas under artificial lights.

### 7.1.3  Focus

- When requested the auto-focus function is enabled for 5-10 sec to find the best focus. Focus is then frozen.

- Focus can be adjusted manually to get better results if the autofocus is not satisfactory.

Notes:

When zooming in, the focus needs to be re-adjusted at 10x zoom.

When zooming tight, the quality of the dome (blemishes, dirt, scratches) will create distortion and render the image blurry.

Occultation (objects close to the camera in the field of view) also makes the image blurry when zooming tight:  The IR turret dome when looking forward, the floor of the canoe when looking sideways, the blimp bridles do come into the Field-Of-View and blur out the image without the operator realizing it because such objects are out-of-focus.

### 7.1.4  Image Stability[1]

- Hands-off operations at zoom 36x (1.8°, 31 mils) in 10 mph wind with properly trimmed blimp

- Hands-off operations at zoom 25x (2.5°, 44 mils) in 25 mph wind with properly trimmed blimp

---

[1]  PRELIMINARY

## 7.2    LWIR System:  DRS-E6000

### 7.2.1  Field Of View (Horizontal)

- 15° (262 mils)      at zoom 1x

- 5°  (87 mils)      at zoom 3x (digital)


Notes:

Aspect Ratio   4/3 (Horizontal Field-Of-View = 4/3 * Vertical Field Of View, standard TV format)

Zoom: The zoom function on the DRS –E6000imager is digital.  The AltiCam 2008 GUI interface has a 1x to 2x digital zoom that may be used instead.


### 7.2.2  Brightness

Image Brightness / Contrast are controlled by:

- Flat Field Correction and Gain Adjust

- Brightness adjust

- Contrast adjust


Notes:

When the image-auto adjust button is pressed, the imager re-computes the best balance and adjust its gains.  The gains are then frozen so that the image does not beat as the imager moves around.

The LWIR imager can be used day and night.


If the imager is accidentally pointed directly into the Sun, the image will fade away.  The imager will recover in about 2 minutes.

### 7.2.3  Focus

- Manual focus

Notes:

The focus adjust has a very large range sized to correct for temperature effects

The focus change required to compensate for a 10°C temperature change is equivalent to the focus range required at one temperature to focus from 10m to infinity.

The focus range is from 1 (far) to 255 (near).  The focus button commands steps of 8.

Use the full range of focus if necessary until an acceptable setting is found.  During night operations, focus will have to be trimmed to compensate for temperature changes.

### 7.2.4  Image Stability[2]

- Hands-off operations at zoom 3x (5°, 87 mils) in 25 mph wind with properly trimmed blimp

---

[2] PRELIMINARY

# 8.    Trouble Shooting & Recommendations

## 8.1    Powering Down

Power must be turned off before the blimp can be reeled in.  Disconnect the system before powering down by pressing the <mark>disconnect</mark> button.

## 8.2    Connecting to the Video and MultiPort Servers

REBOOT the computer whenever the following occurs:

- the computer is not properly shut down;

- the computer is not powered and goes to sleep mode;

- power is turned off before the GUI is disconnected ( <mark>disconnect</mark> button );

- a TCP/IP error is detected and forces the User Interface application to shut down (bad tether);

It is possible that the EOP shows a proper connection (XE104 utility, see 1.4.3) but the GUI cannot connect to either the Video Server (192.168.16.210) or the MultiPort server (192.168.16.230).

If rebooting the computer does not solve the problem, recycle tether power as well.

## 8.3    Trouble Shooting Communication

The "Diagnostics" folder contains shortcuts to several debugging utilities:

- Start the NETGEAR XE104 Powerline Encryption utility to verify that the EOP is working properly.  The utility scans and tries to detect a NETGEAR XE104 on the power line.  When detected, it provides an estimate of the baud rate.  85 Mbps (mega-bit per seconds) is the maximum rate.  If no device is detected: power is not on; the payload is not connected; the tether is damaged.  No encryption is used since the tether is the only 60Hz "net".

- Start the IPUtility to detect the video server.  The server should be detected and have the IP address 192.168.16.210.  If not, this address should be set using the IPutility. **The video server is set up before delivery and is unlikely to need resetting**. **This utility can be useful if a spare is delivered from the factory.**

- Start the digiport utility to detect the Port Server.  The server should be detected and have the IP address 192.168.16.230.  Each port should be set up as TCP socket.  The serial baud rate should be 57,600 bps.  If not, the utility can be used to reset the parameters.  **The video server is set up before delivery and is unlikely to need resetting**.  **This utility can be useful if a spare is delivered from the factory.**

- The X-CTU application is used in conjunction with a 9Xtend radio modem, an alternative to the Serial Port server.

- AltiCam Engineering is a full turret debugging program that can help Hood Technology debug a system in case it misbehaves.
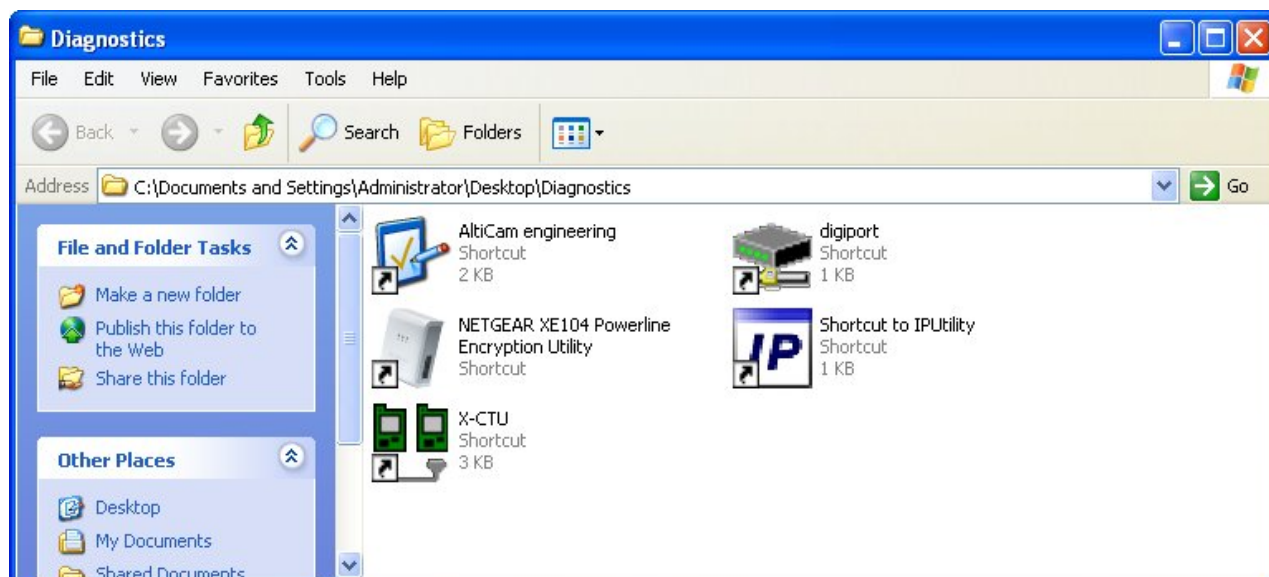
**Figure 11:  The Diagnostics folder contains shortcuts to debugging utilities**

## 8.4    Trouble Shooting the Tether and the Inverter

The tether might be damaged (including the various connectors) and/or the inverter might be damaged whenever the following occurs:

- TCP/IP errors are detected and the Ground Station utility is shut down frequently.
- The NETGEAR communication rate drops below 40 Mbps.
- The Frame Rate drops below 10 FPS.
- The turrets respond slowly and commands are dropped (for example zoom does not stop and go to full wide or full tight).

In that case contact Hood Technology.

## 8.5    Power Up Sequence: Booting Delays

The video server powers up faster than the MultiPort application.

Typically it takes 30 seconds to 1 minute for the video server to respond and up to 2 minutes for the Port Server to respond.

## 8.6    Saving Videos

Videos and stills are automatically named based on the laptop date and time:

- yy-mm-dd_hh.mm.ss.avi for video
- yy-mm-dd_hh.mm.ss.jpg for stills

To change the time (EST, PCT, Zulu) use the Windows clock application.

To manage the recordings, the directory where the videos are stored can be selected by the operator.